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# Field Performance Evaluation of Polymer Coated CSP Structures in NEW YORK

*Prepared for:*

**NATIONAL CORRUGATED STEEL PIPE ASSOCIATION**

*March 2002*

## OBJECTIVES

The objectives of this study were to evaluate polymer coated pipes in New York State that were identified by New York State Department of Transportation (DOT) personnel. These pipes were evaluated by the DOT in 1998. This study provides for a closer inspection of the coating condition and collection of environmental data. These structures are also unique because they are asphalt paved over polymer coated corrugated steel pipe (CSP).

## CONCLUSIONS:

- The polymer coated CSP has performed very well at 19 of the 20 sites inspected. One installation showed signs of blistering over less than one percent of the pipe and is considered an anomaly. (See discussion Site 30/2206/1296)
- The asphalt paving shows excellent adhesion to the polymer coating. Even where the exposed ends of the asphalt paving show signs of cracking, the asphalt still bonds well to the polymer coating.
- The combined asphalt paving and polymer coating performed well under the severe abrasive sites.
- In comparison, the sites that showed various levels of corrosion on the plain galvanized end sections still had very good performance for the polymer coating. It should be noted that some of the sites had very low hardness levels ("soft" water) which may explain the corrosion of the galvanized end sections.
- The condition of the pipes was typical of several hundred other pipes the author has inspected, demonstrating consistent performance, regardless of age.

## BACKGROUND

Innovative materials are continually being developed for corrugated steel pipe to increase service life and broaden environmental conditions. One of the best ways to determine the durability of these materials is long-term exposure in a "real-world" installation. Periodic evaluation of the materials over many years increases our comfort at projecting service life. Several polymer-precoated (Dow Trenchcoat) corrugated steel pipes were installed as part of various projects in New York State. In October 1998, New York State DOT personnel inspected over 20 pipes at seven different project locations. The pipes were 6 to 10 years old at the time of that inspection. To enhance the state study, NCSPA commissioned Corrpro Company, Inc. to inspect and evaluate these sites in June 2001. This report details the results of that inspection.

## INSPECTION FINDINGS

On Tuesday, June 26 and Wednesday, June 27, 2001 Corrpro Companies inspected 20 polymer coated and asphalt paved corrugated steel pipe in the state of New York. The pipes ranged in age from 9 to 13 years. With one exception, the pipes were in very good condition. The polymer coating was intact, well adhered, pliable and appeared like new. The asphalt paving was intact through most of the pipe, but beginning to crack at some of the exposed ends. Where cracking was observed, the asphalt still exhibited good adhesion to the polymer. The polymer under the asphalt was still well adhered to the steel. There was minor damage to some of the polymer that was the result of fabricating and handling. Where the galvanized substrate was exposed, there was no significant steel corrosion. At the cut ends, there was typically some steel corrosion and nominally ¼-inch of coating undercutting, typical of 10-year old pipe. These imperfections do not show any signs of impacting the expected service life. Table 1 summarizes the environmental data from each location. Following are detailed observations of each pipe location.

Table 1. Summary of Data Collected

| | | | | Water Data | | | Soil Data | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Road | Section | Mile post | Ecorr, mV | Hardness mg/L | pH | Resistivity, ohm-cm | Percent Moisture | Chloride, ppm | Sulfide, ppm | pH | Resistivity ohm-cm |
| 32 | 1101 | 1085 | -810 | 70 | 6.75 | 2,941 | 9.22% | 7 | 0 | 7.4 | 7,813 |
| 32 | 1104 | 1072 | -847 | 110 | 6.79 | 5,291 | 10.87% | 14 | 0 | 6.9 | 11,494 |
| 155 | 1101 | 3053 | N/M | – No Sample – | | | 30.99% | 36 | 0 | 7.5 | 2,268 |
| 155 | 1101 | 3053 | -787 | – No Sample – | | | | – No Sample – | | | |
| 155 | 1101 | 3064 | -714 | 290 | 7.54 | 1,020 | 15.54% | 12 | 0 | 7.9 | 5,814 |
| 155 | 1101 | 3078 | -824 | N/M | 7.55 | 613 | 12.84% | 8 | 0 | 8.1 | 6,369 |
| 30 | 2206 | 1714 | -748 | 34 | 7.46 | 3,846 | 24.27% | 25 | 0.3 | 7.2 | 4,310 |
| 30 | 2206 | 1715 | -832 | 13.6 | 6.5 | 12,500 | No Sample | | | | |
| 30 | 2206 | 1710 | -721 | 6.8 | 4.93 | 26,316 | 16.99% | 15 | 0 | 6.8 | 5,376 |
| 30 | 2206 | 1704 | -648 | 39 | 6.43 | 6,623 | 15.75% | 7 | 0 | 7.9 | 4,386 |
| 30 | 2206 | 1698 | N/M | – No Sample – | | | | – No Sample – | | | |
| 30 | 2206 | 1314 | -908 | – Dry – | | | 6.62% | 11 | 0 | 6.6 | 25,641 |
| 30 | 2206 | 1310 | -633 | N/M | 7.48 | 3,571 | 12.43% | 12 | 0 | 5.9 | 25,000 |
| 30 | 2206 | 1296 | -563 | 45 | 6.33 | 5,000 | 8.91% | 11 | 0 | 6.3 | 15,873 |
| 30 | 2206 | 1291 | -793 | 50 | 6.43 | 23,810 | 9.25% | 10 | 0 | 6.2 | 13,333 |
| 30 | 2206 | 1285 | -696 | 224 | 6.32 | 455 | 5.68% | 8 | 0 | 6.2 | 20,408 |
| 30 | 2206 | 1286 | -724 | 40 | 6.72 | 3,125 | 4.49% | 10 | 0 | 5.6 | 9,259 |
| 30 | 2206 | 1147 | -759 | Dry | – No Sample – | | | | | | |
| 30 | 2206 | 1124 | -766 | 14.4 | 5.87 | 13,333 | 7.03% | 14 | 0 | 7 | 23,810 |
| 30 | 2206 | 1097 | -735 | 4 | 6.54 | 3,704 | 4.35% | 16 | 0 | 6.9 | 16,667 |

### 1991 Project D253962, Rte 143 and 32, Region 1

**32/1101/1085.** This pipe is a 117-inch by 79-inch pipe arch cross drain underneath a two-lane road (Rt 143) just east of the junction of 143 and 32. The pipe arch is constructed of five sections with polymer coated bands. All joints were tight and exhibited no signs of leakage. There was a trickle flow of water at the time of our inspection.

The water resistivity and pH were measured as 2,941 ohm-cm and 6.75, respectively. The soil resistivity and pH were measured as 7,813 ohm-cm and 7.4, respectively.

**COATING CONDITION.** The polymer coating was generally in excellent condition. In some locations along the cut edges, the polymer coating could be lifted from the galvanizing for approximately ¼ inch. There was no metal loss at these edges. At all other locations the coating was well bonded. The asphalt was cracked at the ends of the paved invert where exposed to sunlight, but was well bonded to the polymer. No metal was exposed in the invert.

**32/1104/1072.** This pipe is a 117-inch by 79-inch pipe arch cross drain underneath a two-lane road (Rt 32) just north of the junction of 143 and 32. The pipe arch is constructed of multiple sections with polymer-coated bands. All joints were tight and exhibited no signs of leakage. There was no water at the time of our inspection. There was heavy bedload (rocks) in this pipe.

The water resistivity and pH were measured as 5,291 ohm-cm and 6.79, respectively. The soil resistivity and pH were measured as 11,494 ohm-cm and 6.9, respectively.

**COATING CONDITION.** The polymer coating was generally in excellent condition. However, there were gouges cut through the asphalt along both sides (worse on the south side). The straightness and symmetry of the gouges suggest a mechanical cause. Fresh asphalt was exposed, no metal or polymer coating damage was evident.

In some locations along the cut pipe edges, the polymer coating could be lifted from the galvanizing for approximately ¼ inch. There was no significant metal loss at these edges. At all other locations the coating was well bonded. The asphalt paving was well bonded to the polymer coating.

## COLLECTED DATA

**32/1101/1085**

| | |
|---|---|
| Ecorr, mV | -810 |
| **Water Data** | |
| Hardness, mg/L | 70 |
| pH | 6.75 |
| Resistivity, ohm-cm | 2,941 |
| **Soil Data** | |
| % Moisture | 9.22% |
| Chloride, ppm | 7 |
| Sulfide, ppm | 0 |
| pH | 7.4 |
| Resistivity, ohm-cm | 7,813 |
| Age | 10 years |

**32/1104/1072**

| | |
|---|---|
| Ecorr, mV | -847 |
| **Water Data** | |
| Hardness, mg/L | 110 |
| pH | 6.79 |
| Resistivity, ohm-cm | 5,291 |
| **Soil Data** | |
| % Moisture | 10.87% |
| Chloride, ppm | 14 |
| Sulfide, ppm | 0 |
| pH | 6.9 |
| Resistivity, ohm-cm | 11,494 |
| Age | 10 years |

## 1988 Project D252352, Rte 155, Region 1

**155/1101/3053.** This pipe is a 24-inch diameter cross drain underneath a two-lane road (Rte 155) with an 18-inch diameter side drain connected at a concrete junction. Both pipes consist of multiple sections. All visible joints were tight and exhibited no signs of leakage. Both pipes were dry at the time of our inspection. The soil resistivity and pH were measured as 2,268 ohm-cm and 7.5, respectively.

**COATING CONDITION.** The polymer coating was generally in excellent condition. The polymer coating was tightly adhered, even at the cut edges. The asphalt paving was cracked at the ends of the paved invert where exposed to sunlight, but was well bonded to the polymer. No metal was exposed in the invert.

The galvanized end sections did not exhibit any steel corrosion.

**155/1101/3064.** This pipe is a 48-inch cross drain underneath a two-lane road (Rte 155). The pipe is constructed of four sections with polymer-coated bands. Two of the sections had field cut ends that resulted in a mismatch at one joint. There was approximately 6 to 12 inches of flowing water at the time of our inspection. There was heavy bedload (rocks) in the invert of the pipe.

The water resistivity and pH were measured as 1,020 ohm-cm and 7.54, respectively. The soil resistivity and pH were measured as 5,814 ohm-cm and 7.9, respectively.

**COATING CONDITION.** The polymer coating was generally in excellent condition. In some locations along the cut edges, the polymer coating could be lifted from the galvanizing for approximately ¼ inch. There was no significant metal loss at these edges. At all other locations the coating was well bonded. Where the field cuts were made, there was metal saw filings embedded in the polymer coating that exhibited corrosion. This should not be mistaken for corrosion of the substrate. The asphalt was well bonded to the polymer.

At the galvanized end section, all of the galvanizing was consumed and there was corrosion below the waterline. Above the waterline, the galvanized was in tact on the end sections.

**155/1101/3078.** This 42-inch by 29-inch pipe arch is a cross drain underneath a two-lane road (Rte 155) immediately adjacent to Bison Road. A concrete drain connects two pipe sections. All joints were tight and exhibited no signs of leakage. There was a trickle flow of water a few inches deep at the time of our inspection.

The water resistivity and pH were measured as 613 ohm-cm and 7.55, respectively. The soil resistivity and pH were measured as 6,369 ohm-cm and 8.1, respectively.

**COATING CONDITION.** The polymer coating was generally in excellent condition. In some locations along the cut edges, the polymer coating could be lifted from the galvanizing for approximately ¼ inch. At the extreme bottom of the invert on one end, the coating could be lifted back as far as one inch. There was no significant metal loss at these edges. At all other locations the coating was well bonded. The asphalt was well bonded to the polymer. No metal was exposed in the invert.

The galvanized end section had some localized corrosion at the waterline, but was in generally good condition.

## COLLECTED DATA

### 155/1101/3053

| | |
|---|---|
| Ecorr, mV | N/M |
| **Water Data** | |
| Hardness, mg/L | |
| pH | – NO SAMPLE – |
| Resistivity, ohm-cm | |
| **Soil Data** | |
| % Moisture | 30.99% |
| Chloride, ppm | 36 |
| Sulfide, ppm | 0 |
| pH | 7.5 |
| Resistivity, ohm-cm | 2,268 |
| Age | 13 years |

### 155/1101/3064

| | |
|---|---|
| Ecorr, mV | -714 |
| **Water Data** | |
| Hardness, mg/L | 290 |
| pH | 7.54 |
| Resistivity, ohm-cm | 1,020 |
| **Soil Data** | |
| % Moisture | 15.54% |
| Chloride, ppm | 12 |
| Sulfide, ppm | 0 |
| pH | 7.9 |
| Resistivity, ohm-cm | 5,814 |
| Age | 13 years |

### 155/1101/3078

| | |
|---|---|
| Ecorr, mV | -824 |
| **Water Data** | |
| Hardness, mg/L | N/M |
| pH | 7.55 |
| Resistivity, ohm-cm | 613 |
| **Soil Data** | |
| % Moisture | 12.84% |
| Chloride, ppm | 8 |
| Sulfide, ppm | 0 |
| pH | 8.1 |
| Resistivity, ohm-cm | 6,369 |
| Age | 13 years |

## 1990 Project D253641, Rte 30, Region 2

**30/2206/1714.** This site includes two, 30-inch pipes. One pipe is a cross drain underneath a two-lane road (Rte 30). The second pipe is side drain on the east side of the road which diverts water around an existing property. The two pipes are connected at a concrete collection basin. The pipes are constructed of multiple sections. All joints appear to be tight, exhibiting no signs of leakage. There was water flow at the time of our inspection. There was approximately 9 inches of gravel in the invert of the pipe.

The water resistivity and pH were measured as 3,846 ohm-cm and 7.46, respectively. The soil resistivity and pH were measured as 4,310 ohm-cm and 7.2, respectively.

**COATING CONDITION.** The polymer coating was generally in excellent condition. In some locations along the cut edges, the polymer coating could be lifted from the galvanizing for approximately ¼ inch. There was no significant metal loss at these edges. At all other locations the coating was well bonded. On one side of the waterline at the outlet of the side drain, the coating could be lifted back as far as one inch. The asphalt was well bonded to the polymer.

The galvanized end section at the outlet of the side drain was perforated just above the waterline. This occurred immediately adjacent to the location where the polymer coating could be lifted up to one inch.

**30/2206/1715.** This pipe is a 30-inch diameter cross drain underneath a two-lane road (Rte 30). The pipe is constructed of multiple sections with polymer-coated bands. All joints were tight and exhibited no signs of leakage. There was a trickle flow of water at the time of our inspection.

The water resistivity and pH were measured as 12,500 ohm-cm and 6.5, respectively. Soil samples were not taken at this site.

**COATING CONDITION.** The polymer coating was generally in excellent condition. In some locations along the cut edges, the polymer coating could be lifted from the galvanizing for approximately ¼ inch. There was no significant metal loss at these edges. At all other locations the coating was well bonded. The asphalt was well bonded to the polymer. No metal was exposed in the invert.

The galvanized end section had rust staining and some rusting steel in the invert. The staining made the extent of corrosion look slightly worse.

**30/2206/1710.** This pipe is a 36-inch cross drain underneath a two-lane road (Rte 30). The pipe includes a polymer-coated extension on either end of a concrete pipe. The length of the extension is nominally 6 feet on the west side and 4 feet on the east side. Both joints were tight and exhibited no signs of leakage. The pipe was installed on a steep slope and there was flowing water at the time of our inspection.

The water resistivity and pH were measured as 26,316 ohm-cm and 6.8, respectively. The soil resistivity and pH were measured as 5,376 ohm-cm and 6.8, respectively.

**COATING CONDITION.** The concrete pipe had approximately 1 inch of wear in the invert, exposing aggregate. The polymer coating was generally in excellent condition. In some locations along the cut edges, the polymer coating could be lifted from the galvanizing for approximately ¼ inch. There was no significant metal loss at these edges. At all other locations the coating was well bonded. The asphalt was well bonded to the polymer. No metal was exposed in the invert.

## COLLECTED DATA

### 30/2206/1714

| | |
|---|---|
| Ecorr, mV | -748 |
| **Water Data** | |
| Hardness, mg/L | 34 |
| pH | 7.46 |
| Resistivity, ohm-cm | 3,846 |
| **Soil Data** | |
| % Moisture | 24.27% |
| Chloride, ppm | 25 |
| Sulfide, ppm | 0.3 |
| pH | 7.2 |
| Resistivity, ohm-cm | 4,310 |
| Age | 11 years |

### 30/2206/1715

| | |
|---|---|
| Ecorr, mV | -832 |
| **Water Data** | |
| Hardness, mg/L | 13.6 |
| pH | 6.5 |
| Resistivity, ohm-cm | 12,500 |
| **Soil Data** | |
| % Moisture | |
| Chloride, ppm | |
| Sulfide, ppm | – NO SAMPLE – |
| pH | |
| Resistivity, ohm-cm | |
| Age | 11 years |

### 30/2206/1710

| | |
|---|---|
| Ecorr, mV | -721 |
| **Water Data** | |
| Hardness, mg/L | 68 |
| pH | 4.93 |
| Resistivity, ohm-cm | 26,316 |
| **Soil Data** | |
| % Moisture | 16.99% |
| Chloride, ppm | 15 |
| Sulfide, ppm | 0 |
| pH | 6.8 |
| Resistivity, ohm-cm | 5,376 |
| Age | 11 years |

**30/2206/1704.** This pipe is a 24-inch cross drain underneath a two-lane road (Rte 30). The pipe is a 4.5-foot extension on one end of an existing concrete pipe. There was a trickle flow of water at the time of our inspection.

The water resistivity and pH were measured as 6,623 ohm-cm and 6.43, respectively. The soil resistivity and pH were measured as 4,386 ohm-cm and 7.9, respectively.

**COATING CONDITION.** The polymer was in good condition except for a small area of delamination at the cut edge — nominally 1 inch back along eight inches of edge just above the paved invert. The galvanized end section was rusting below the waterline and perforated in a small area.

**30/2206/1698.** This pipe is one of 5 18-inch diameter side drains underneath driveways along side of route 30. These pipes were typically dry, had limited mechanical damage on the exposed exterior ends, and were otherwise in good shape.

**COATING CONDITION.** The polymer was well adhered and pliable. The paved invert was also well adhered, though some cracking existed at the exposed ends. No water or soil samples were taken.

## COLLECTED DATA

### 30/2206/1704

| | |
|---|---|
| Ecorr, mV | -648 |
| **Water Data** | |
| Hardness, mg/L | 39 |
| pH | 6.43 |
| Resistivity, ohm-cm | 6,623 |
| **Soil Data** | |
| % Moisture | 15.75% |
| Chloride, ppm | 7 |
| Sulfide, ppm | 0 |
| pH | 7.9 |
| Resistivity, ohm-cm | 4,386 |
| Age | 11 years |

### 30/2206/1698

| | |
|---|---|
| Ecorr, mV | N/M |
| **Water Data** | |
| Hardness, mg/L | |
| pH | – NO SAMPLE – |
| Resistivity, ohm-cm | |
| **Soil Data** | |
| % Moisture | |
| Chloride, ppm | |
| Sulfide, ppm | – NO SAMPLE – |
| pH | |
| Resistivity, ohm-cm | |
| Age | 11 years |

## 1991 Project D253716 Rte 30 Region 2

**30/2206/1314.** This pipe is a 30-inch diameter cross drain underneath a two-lane road (route 30).

The pipe was dry at the time of inspection. The soil resistivity and pH were measured as 25,641 ohm-cm and 6.6, respectively.

**COATING CONDITION.** The Paved invert was cracked for about the first foot on the exposed end. There was less than ¼ inch delamination from the cut ends. The galvanized end section had some minor corrosion in the invert.

**30/2206/1310.** This pipe is a 24-inch diameter cross drain underneath a two-lane road (route 30). There was a trickle flow of water at the time of our inspection.

The water resistivity and pH were measured as 3,571 ohm-cm and 7.48, respectively. The soil resistivity and pH were measured as 25,000 ohm-cm and 5.9, respectively.

**COATING CONDITION.** The polymer coating was generally in excellent condition. Even at the cut ends, the polymer coating was well adhered with the exception of a 4-inch length along what appeared to be a waterline. At this location approximately one inch of the polymer could be lifted. There was no corrosion under the small piece of delaminated film.

The outlet end section (galvanized) was totally perforated in the invert. The inlet end section was badly rusted with no obvious perforation.

## COLLECTED DATA

### 30/2206/1314

| | |
|---|---|
| Ecorr, mV | -908 |
| **Water Data** | |
| Hardness, mg/L | |
| pH | – DRY – |
| Resistivity, ohm-cm | |
| **Soil Data** | |
| % Moisture | 6.62% |
| Chloride, ppm | 11 |
| Sulfide, ppm | 0 |
| pH | 6.6 |
| Resistivity, ohm-cm | 25,641 |
| Age | 10 years |

### 30/2206/1310

| | |
|---|---|
| Ecorr, mV | -633 |
| **Water Data** | |
| Hardness, mg/L | N/M |
| pH | 7.48 |
| Resistivity, ohm-cm | 3,571 |
| **Soil Data** | |
| % Moisture | 12.43% |
| Chloride, ppm | 12 |
| Sulfide, ppm | 0 |
| pH | 5.9 |
| Resistivity, ohm-cm | 25,000 |
| Age | 10 years |

**30/2206/1296.** This pipe is a 48-inch equalizer/cross drain underneath a two-lane road (route 30) that connects two bogs. At the time of the inspection, there was 10 inches of water flowing toward the east. The pipe is constructed of six sections with polymer-coated bands. All joints were tight and exhibited no signs of leakage.

The water resistivity and pH were measured as 5,000 ohm-cm and 6.33, respectively. The soil resistivity and pH were measured as 15,873 ohm-cm and 6.3, respectively.

**COATING CONDITION.** The galvanized end sections were severely rusted with some perforations. Several blisters of varying sizes were noted in the polymer coating. They appeared to be worse at the typical water line on the south wall of the first section of pipe on the east, but they were noted at other locations. When the blistered polymer was removed, there were distinct slits up to three inches long, with adjacent corrosion occurring from the edges. The metal appeared to have been cut or gauged through to the polymer from the outside, though the inside film was intact. Based on the linear shape and distinctiveness of the steel loss, we do not believe this was due to corrosion. The steel must have been cut through the majority of it's thickness prior to installation. Further investigation would be required to determine exactly what happened. It should also be noted that the environmental conditions at this site are most likely more aggressive than the data suggests. The soil sample was retrieved from the fill slope and not indicative of the corrosive soils behind the blisters. Also, bogs such as this tend to have lower pH and resistivity readings. There was active corrosion of the steel at the defects. It is of interest that this pipe is the only pipe to have an electrochemical potential less active than -600mV (-563mV), which is indicative of steel corrosion.

## COLLECTED DATA

**30/2206/1296**

| | |
|---|---|
| Ecorr, mV | -563 |
| **Water Data** | |
| Hardness, mg/L | 45 |
| pH | 6.33 |
| Resistivity, ohm-cm | 5,000 |
| **Soil Data** | |
| % Moisture | 8.91% |
| Chloride, ppm | 11 |
| Sulfide, ppm | 0 |
| pH | 6.3 |
| Resistivity, ohm-cm | 15,873 |
| Age | 10 years |

**30/2206/1291.** This pipe is a 24-inch diameter cross drain underneath a two-lane road (route 30). There was approximately 1-inch of flowing water at the time of our inspection.

The water resistivity and pH were measured as 23,810 ohm-cm and 6.43, respectively. The soil resistivity and pH were measured as 13,333 ohm-cm and 6.2, respectively.

**COATING CONDITION.** The west end of the pipe was polymer coated and paved with a mechanical deformation in the top of the pipe approximately 3 feet from the end. The paved invert was cracked at the exposed end (approximately 1 foot). The paved invert was well adhered, though a small piece was removed near the end. The polymer was in excellent shape under the asphalt paving (e.g., well adhered, pliable, like new condition).

As a comparison, the east end of the pipe was asphalt coated and paved galvanized pipe. The paving had completely delaminated from 1-2 feet near the exposed end. The invert was rusting where the asphalt had come off. The galvanizing was in good shape where the asphalt was still intact.

The galvanized end section had slight corrosion.

**30/2206/1285.** This pipe is a 48-inch cross drain underneath a two-lane road (route 30). The pipe is constructed of multiple sections with plain galvanized bands. There was a trickle flow of water at the time of our inspection.

The water resistivity and pH were measured as 455 ohm-cm and 6.32, respectively. The soil resistivity and pH were measured as 9,259 ohm-cm and 5.6, respectively.

**COATING CONDITION.** The polymer coating had some mechanical damage, but was well adhered. The asphalt paving was well adhered inside with some mechanical damage and cracking at the exposed ends. One of the cut ends in the pipe interior has a few square inches of delamination from the cut edge in the invert.

As a comparison, the galvanized bands were severely corroded in the invert with some perforation, especially around the water line. The galvanized end sections were both rusted in the invert; the inlet (west) end was perforated in some locations.

**30/2206/1286.** This pipe is a 30-inch cross drain underneath a two-lane road (route 30). There was approximately 1-inch of flowing water at the time of our inspection.

The water resistivity and pH were measured as 3,125 ohm-cm and 6.72, respectively. The soil resistivity and pH were measured as 9,259 ohm-cm and 5.6, respectively.

**COATING CONDITION.** The polymer coating was generally in excellent condition. In some locations along the cut edges, the polymer coating could be lifted from the galvanizing for approximately ¼ inch. There was no significant metal loss at these edges. At all other locations the coating was well bonded. The asphalt was cracked at the ends of the paved invert, but was well bonded to the polymer. No metal was exposed in the invert.

The galvanized end sections showed corrosion in the invert.

## COLLECTED DATA

### 30/2206/1291

| | |
|---|---|
| Ecorr, mV | -793 |
| **Water Data** | |
| Hardness, mg/L | 50 |
| pH | 6.43 |
| Resistivity, ohm-cm | 23,810 |
| **Soil Data** | |
| % Moisture | 9.25% |
| Chloride, ppm | 10 |
| Sulfide, ppm | 0 |
| pH | 6.2 |
| Resistivity, ohm-cm | 13,333 |
| Age | 10 years |

### 30/2206/1285

| | |
|---|---|
| Ecorr, mV | -696 |
| **Water Data** | |
| Hardness, mg/L | 224 |
| pH | 6.32 |
| Resistivity, ohm-cm | 455 |
| **Soil Data** | |
| % Moisture | 5.68% |
| Chloride, ppm | 8 |
| Sulfide, ppm | 0 |
| pH | 6.2 |
| Resistivity, ohm-cm | 20,408 |
| Age | 10 years |

### 30/2206/1286

| | |
|---|---|
| Ecorr, mV | -724 |
| **Water Data** | |
| Hardness, mg/L | 40 |
| pH | 6.72 |
| Resistivity, ohm-cm | 3,125 |
| **Soil Data** | |
| % Moisture | 4.49% |
| Chloride, ppm | 10 |
| Sulfide, ppm | 0 |
| pH | 5.6 |
| Resistivity, ohm-cm | 9,259 |
| Age | 10 years |

## 1992 Project D253965 Rte 8 Region 2

**30/2206/1147.** This pipe is an 18-inch side drain underneath a side road (East Shore) along route 8. The pipe was dry at the time of our inspection. No soil or water samples were taken at this site.

**COATING CONDITION.** The polymer coating was generally in excellent condition. The polymer coating is well bonded, even at the pipe edges. There was no significant metal loss at these edges. The asphalt was well bonded to the polymer. No metal was exposed in the invert.

The galvanized end sections were in good shape (no corrosion and galvanizing intact).

**30/2206/1124.** This pipe is a 24-inch cross drain underneath a two-lane road (route 8). There was a trickle flow of water at the time of our inspection.

The water resistivity and pH were measured as 13,333 ohm-cm and 5.87, respectively. The soil resistivity and pH were measured as 23,810 ohm-cm and 7.0, respectively.

**COATING CONDITION.** The inlet end of the pipe was polymer coated and asphalt paved. The polymer coating was generally in excellent condition. In some locations along the cut edges, the polymer coating could be lifted from the galvanizing for approximately ½ inch. There was no significant metal loss at these edges. At all other locations the coating was well bonded. The asphalt was cracked at the ends of the paved invert, but was well bonded to the polymer. No metal was exposed in the invert.

The outlet end of the pipe was asphalt coated galvanized steel. The asphalt and galvanizing was almost completely removed below the waterline. The steel was actively corroding, but still sound.

The galvanized end sections had active corrosion below the waterline but were not perforated.

**30/2206/1097.** This pipe is a 30-inch cross drain underneath a two-lane road (route 8). The pipe includes polymer-coated extensions on either end of a length of galvanized pipe.

The water resistivity and pH were measured as 3,704 ohm-cm and 6.54, respectively. The soil resistivity and pH were measured as 16,667 ohm-cm and 6.9, respectively. There was a flow of water several inches deep at the time of our inspection.

**COATING CONDITION.** The polymer coating is in good shape. The paved invert is cracking at the exposed ends, but is intact. The galvanized pipe is rusting below the waterline. Both end sections are rusting below the waterline.

## COLLECTED DATA

### 30/2206/1147

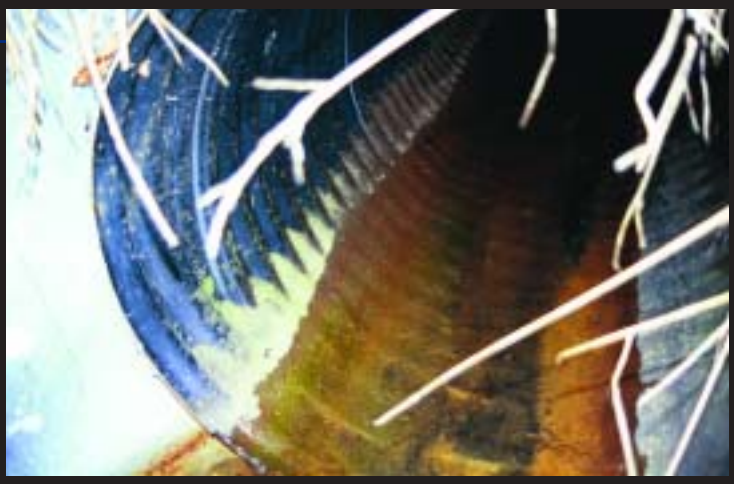
| | |
|---|---|
| Ecorr, mV | -759 |
| **Water Data** | |
| Hardness, mg/L | |
| pH | – DRY – |
| Resistivity, ohm-cm | |
| **Soil Data** | |
| % Moisture | |
| Chloride, ppm | |
| Sulfide, ppm | – NO SAMPLE – |
| pH | |
| Resistivity, ohm-cm | |
| Age | 9 years |

### 30/2206/1124

| | |
|---|---|
| Ecorr, mV | -766 |
| **Water Data** | |
| Hardness, mg/L | 14.4 |
| pH | 5.87 |
| Resistivity, ohm-cm | 13,333 |
| **Soil Data** | |
| % Moisture | 7.03% |
| Chloride, ppm | 14 |
| Sulfide, ppm | 0 |
| pH | 7 |
| Resistivity, ohm-cm | 23,810 |
| Age | 9 years |

### 30/2206/1097

| | |
|---|---|
| Ecorr, mV | -735 |
| **Water Data** | |
| Hardness, mg/L | 4 |
| pH | 6.54 |
| Resistivity, ohm-cm | 3,704 |
| **Soil Data** | |
| % Moisture | 4.35% |
| Chloride, ppm | 16 |
| Sulfide, ppm | 0 |
| pH | 6.9 |
| Resistivity, ohm-cm | 16,667 |
| Age | 9 years |



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